Evaluation of Planting Techniques for Restoration Projects on the Shasta River

Prepared by Great Northern Corporation for the Shasta River Coordinated Resource Management Plan Organization, the Shasta Valley Watershed Group

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INTRODUCTION

Projects to assist in the restoration of the riparian areas of the Shasta River watershed have been attempted since 1988. These initial projects led to a formal Shasta River Coordinated Resource Management Plan (CRMP) in 1990. The goal of the CRMP is to improve the fisheries habitat along the Shasta River so as to increase anadromous fish survival. Numerous projects under taken by the CRMP process have included stream bank stabilization, livestock control fencing, and tail water recovery. These projects have been generally judged successful in starting the riparian restoration and stabilization process. Many of these riparian restoration projects utilize some riparian planting to accelerate recovery of vegetation

species to provide shade, woody debris and protection for fish species in the local rivers.

While conducting riparian planting projects, anecdotal information was gathered indicating that a high percentage of the riparian plantings were not surviving. The anecdotal information laid blame on several constraints; predation, soil conditions, lack of water during critical times of the year, and poor planting techniques. A cursory review of sites indicated that predation by beavers is a major factor in lack of survival. (An most sites beaver predation was 100%). The Shasta CRMP determined that a study of beaver control or repellent methods could lead to the development a technique that would dramatically improve the survival of newly planted riparian trees. In 1994 the Klamath River Task Force agreed to fund a study of planting techniques, specifically beaver predation control. After the first year, the study was expanded to include other factors thought to be limiting the riparian planting effort.

The objectives of this project then became to assist in the acceleration of riparian recovery projects by:

- Determining the extent of predation on newly planted riparian species and testing protection measures.

- Determining the best planting practices leading to the highest survival rate of riparian plantings.

- Determining the most cost effective method of planting and protecting the plantings in newly fenced riparian sites.

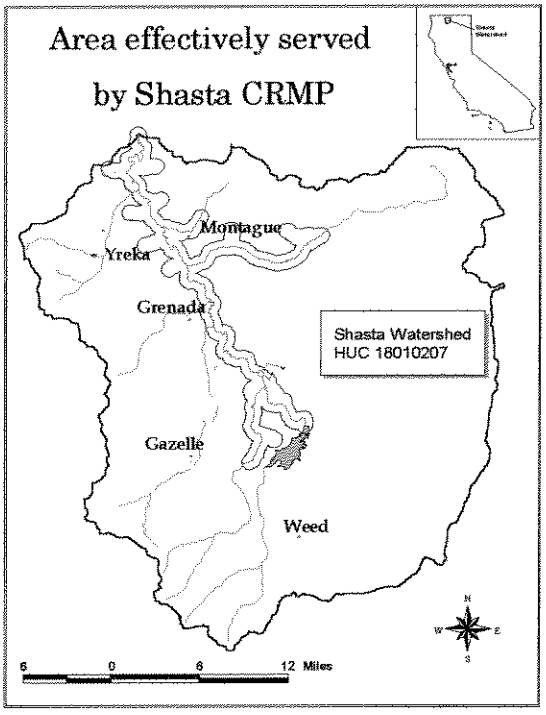
- Determining other environmental constraints to planting survival

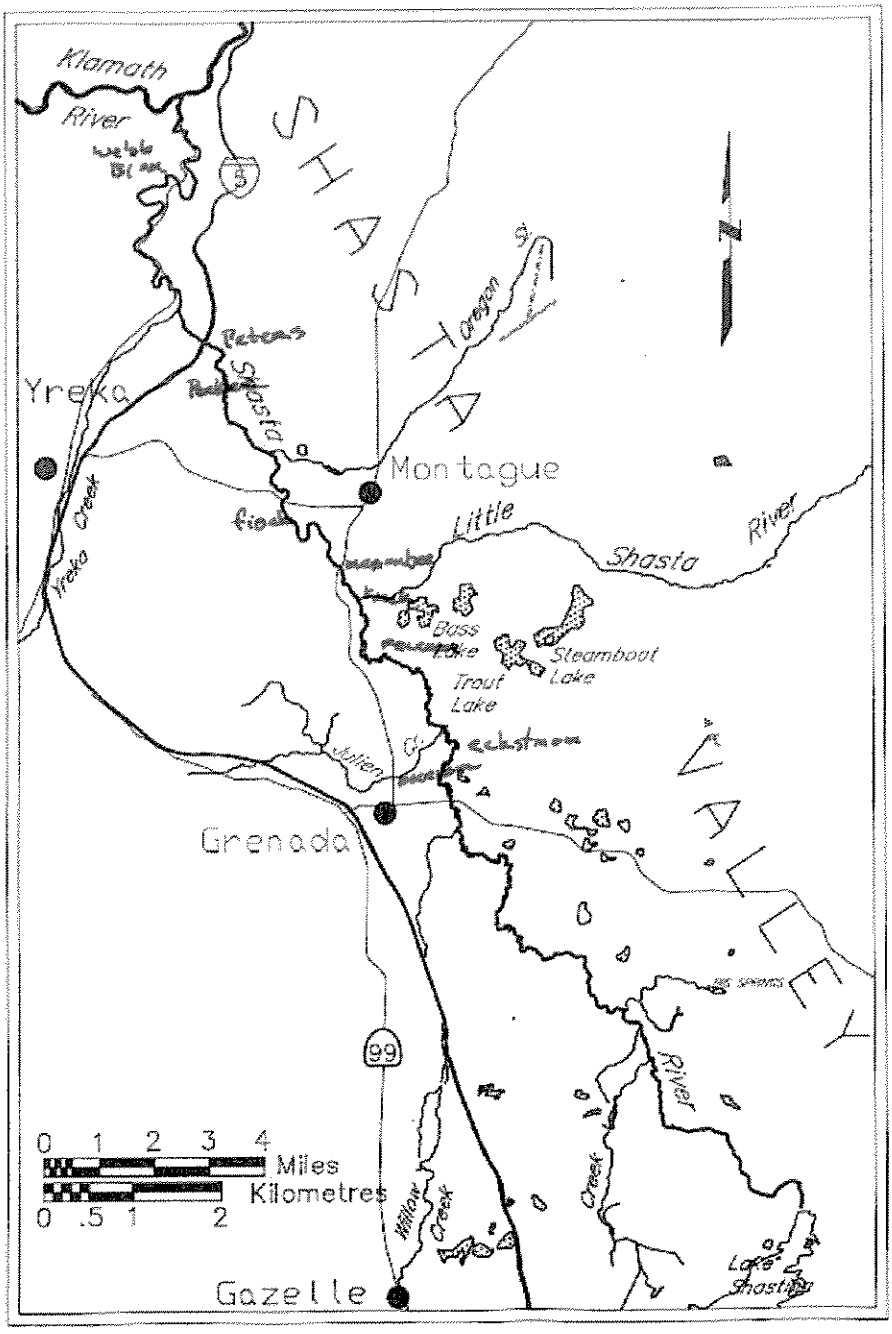
Description of study area:

The ranches where planting has taken place and survival and nonsurvival has been documented include areas in the Shasta River canyon which has pebbly and rock soils (Webb and BLM), at the beginning of the Shasta canyon (near the I5 crossing) with mixed clay, sand and rock soils (Parker and Peters) and through the Shasta Valley with clay soils (Meamber, Kuck, Freeman, Meriam, Eckstrom and Fiock).

Area	Soil type	site name
Shasta River Canyon	pebbly, rocky	webb,blm
I5 crossing	mixed clay, sand rock	parker, peters
Upper River	clays	meamber, kuck, freeman, meriam, eckstrom, fiock

Map of sites




Klamath
River
SHASTA
Yreka
Shasta
Montague
Little
Shasta
River
Yreka Creek
Bass
Steamboat
Lake
Trout
Lake
Grenada
SCOTT
VALLEY
99
0 1 2 3 4
Miles
Kilometres
0 .5 1 2
Gazelle
Lake
Shasta

The Eckstrom Ranch has approved the use of their riparian livestock exclusion area as a test site for riparian planting methods. The Eckstrom Ranch is in the Shasta Valley approximately 3 miles downstream of the A-12 highway crossing. The Shasta River in this area is slow flowing in clay soils with frequent cutbanks. Only one large willow tree still exist at the site.

METHODS AND MATERIALS:

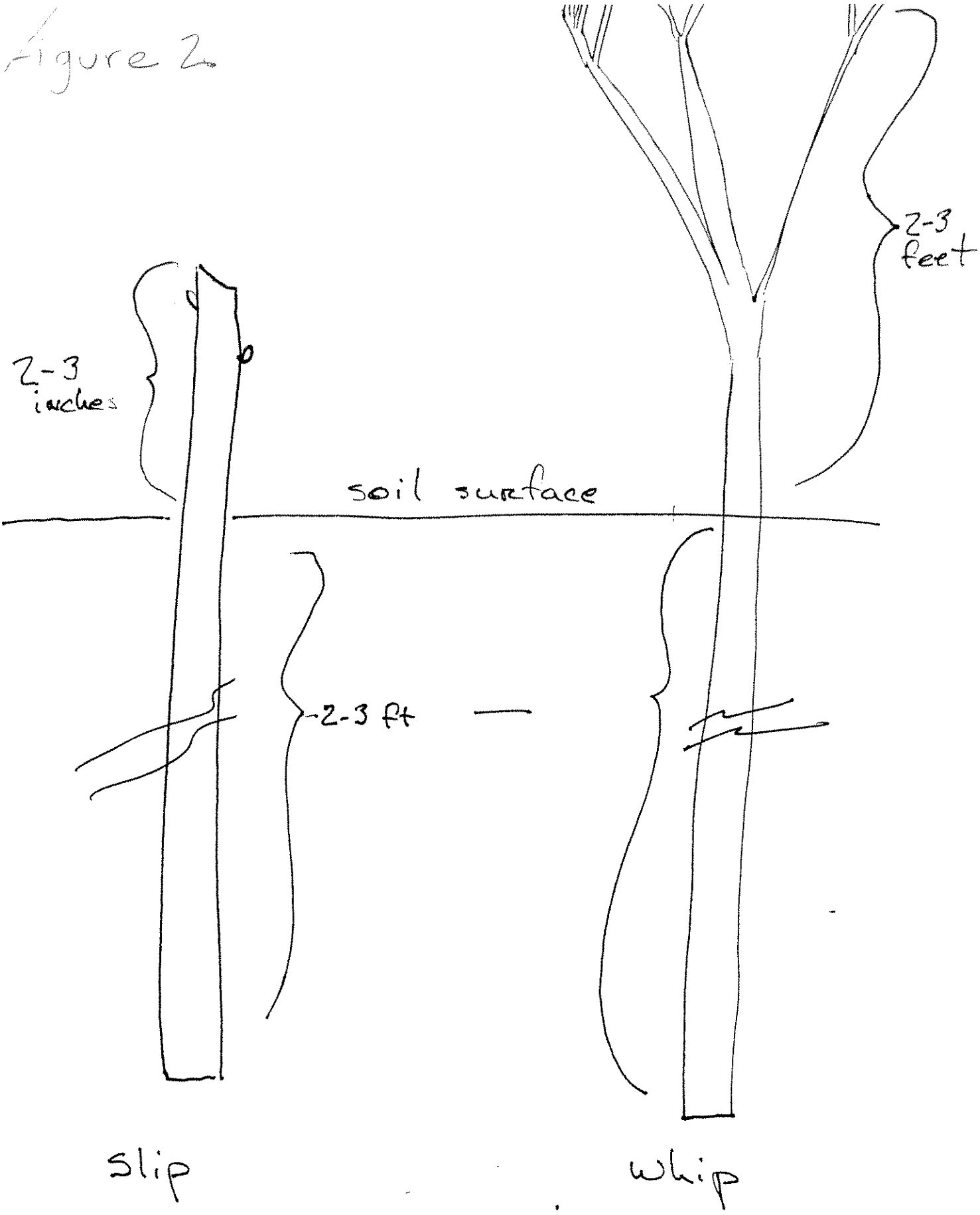
- General Survival Survey

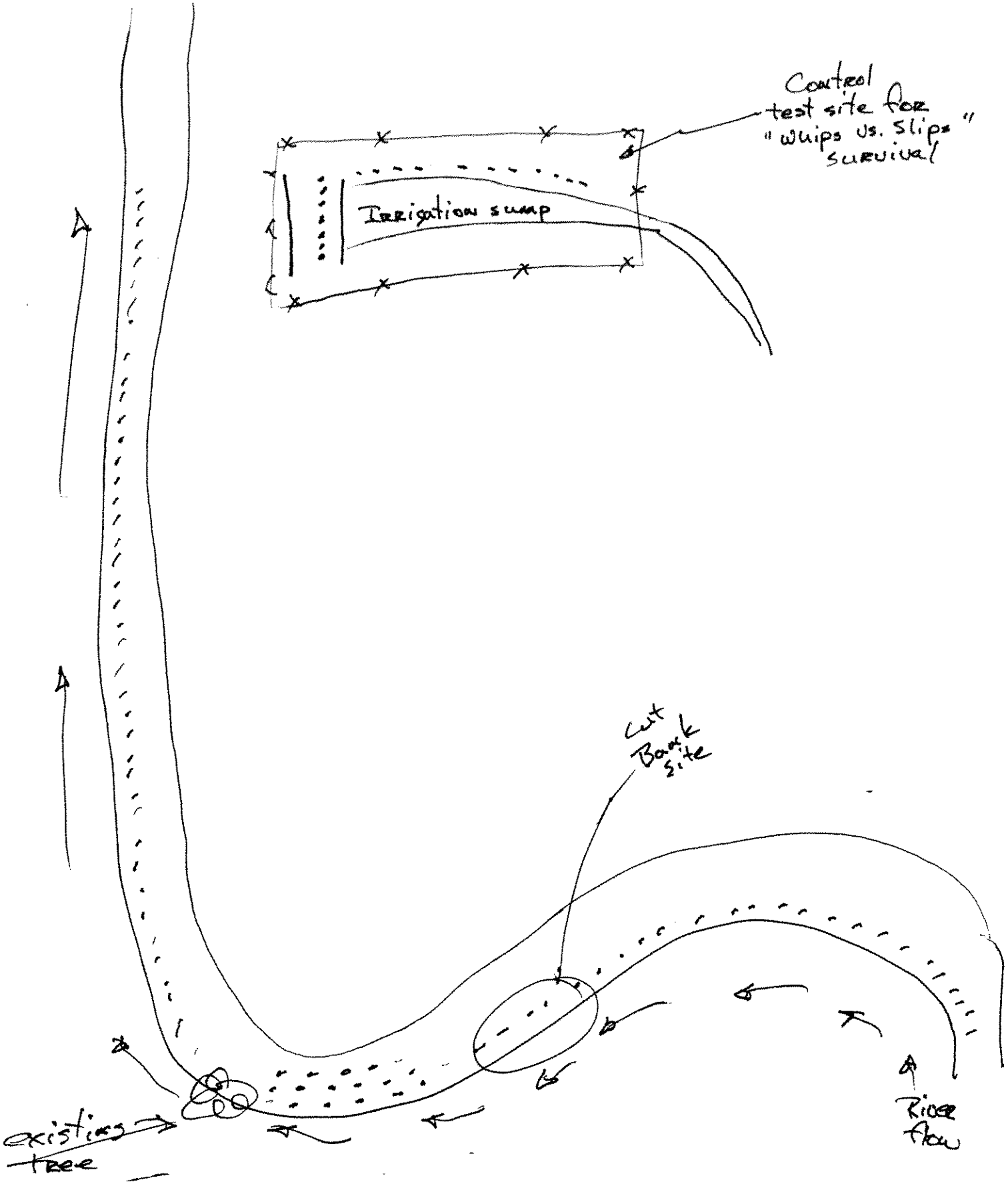
All previously planted sites have been surveyed once during 1994 and twice during 1995, 1996, 1999, 2000 respectively. Data on survival and causes of nonsurvival have been collected.

Most of these sites were planted during the winter of 1994 using two Willow species (Salix laevigata and Salix exigva) and several slip methods principally trimmed slips and nontrimmed whips.

{In this report **slips** will mean live branches trimmed to a 2 to 3 foot length, 1 to 2 inches in diameter and planted 2-3 feet into the soil with 2 nodes above the ground. **Whips** shall refer to live branches not trimmed, 1/2 to 1 1/2 inches in diameter also planted into soil 2 to 3 feet deep. Please see following illustration}

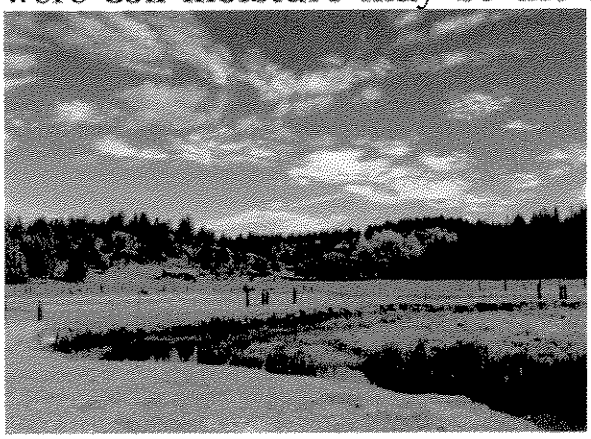
Figure 2.




Control test site for "whips vs. slips" survival
Irrigation sump
cut Bank site
existing tree
River flow

- Whips and Slips "uncontrolled site"

An additional 100 slips and whips (same species and proportions as above) were planted along the Shasta River were soil moisture may be the determining factor for survival.



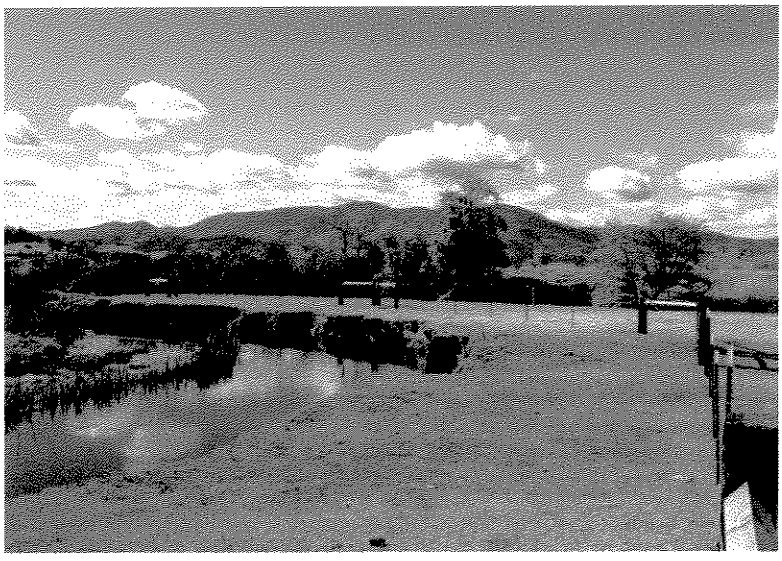
Each planting was protected by a wire basket for beaver protection. This plot will be used to determine if survival without moisture control favors one type of cutting preparation method over another.

- Cut bank planting survival

Several additional slips were planted in cut banks to test their survival compared to slips planted on the banks.

- Dry site test

Over 100 container stock plantings perished in 1996 due to lack of soil moisture even though they were located within 10 feet of the river. Seventy-five Willow (Salix sp.) whips were planted in the same baskets, as the container stock to determine is cuttings survival at a higher rate than container stock.



- Dry sites vs. irrigated sites

Survival of planted materials can be compared between sites of similar soil conditions.

- Cost of protection and irrigation

The cost of protection and irrigation can be determined so that land managers can decide on planting methods using available funds

Results

- General Survival Survey

No natural recruitment was observed above the I5 bridge at any site during the duration of the study from 1994 to 2002.

Blm

750 slips were planted in 1993 with no protection and no irrigation. Surveys in 1995, and 1999 found 203, and 34 growing trees remaining respectively. Although we were not testing the whips vs. slips at this time at least 12 of the surviving trees in 1999 were started from whips, however, this may have been a function of whip placement. The whips were accidentally placed were it would be more difficult for beaver to find them. Several stumps were found during the surveys, indicating beaver predation.

1995 spring

initial planting	replanted	survival	total planted	survival rate
750	0	203	750	27%

1999

initial planting	replanted	survival	total planted	survival rate
750	0	34	350	3%

Peters

200 slips were planted without protection or irrigation in 1993 along with approximately 20 whips. Only 8 survivors were located in 1994 with only 6 survivors in 1998, interestingly, 4 of the 6 survivors were planted as whips.

1994-1998

initial planting	replanted	survival	total planted	survival rate
200	0	8	200	4%

Fiock

An initial planting of container stock in 1996 of 490 with cage protection but without irrigation found 241 survivors in 1997 (49% survival). Replanting 249 slips in 1997 and adding irrigation as well as cage protection found 326 total survivors in 1998. Nearly 100 trees survive in 2002 for survival rate of 13.5%.

1996-1998

initial planting	replanted	survival	total planted	survival rate
490	249	326	739	44%

Kuck

An initial planting of container stock in 1996 of 467 with cage protection and with irrigation found 140 survivors in 1997 (30% survival). Replanting 320 container stock in 1997 and continuing with irrigation as well as cage protection found 82 total survivors in 1998 for a survival rate of 10%.

This site had some bank erosion problems that other sites did not have and so results compared to non-caged and non-irrigated sites must be viewed cautiously.

1996-1998

initial planting	replanted	survival	total planted	survival rate
467	320	82	787	10%

Freeman

Planted in 1997 with 1705 trees, a mixture of container stock and whips, and supplied with irrigation and caged protection. The site was surveyed in early 1998 and then replanted in 1998 with 896 whips. A final survey was completed in fall 1998.

1996-1997

initial planting	replanted	survival	total planted	survival rate
1740	0	1352	1740	87%

1997-1998

initial planting	replanted	survival	total planted	survival rate
1740	0	1104	1740	63%

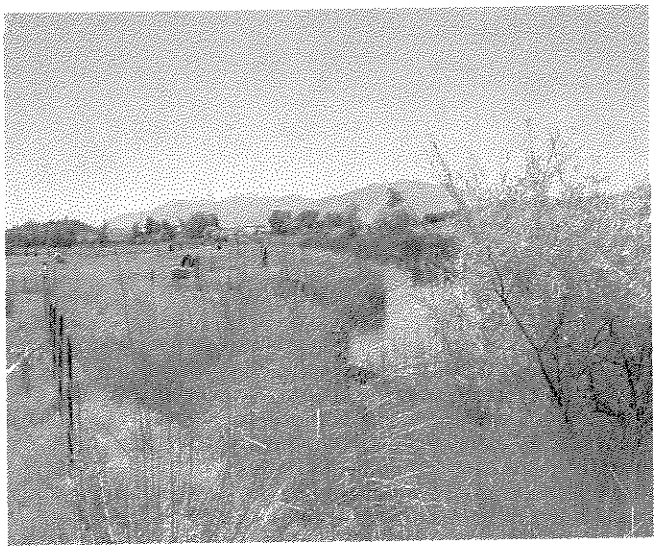
1998 spring

initial planting	replanted	survival	total planted	survival rate
1740	0	743	1740	43%

1998 fall

initial planting	replanted	survival	total planted	survival rate
1740	896	422	2162	66%

Eckstrom



In early spring 1994 1080 plants were planted at 330 sites. 330 each of whips, slips and container plants in protective cages, in addition 100 whips and 100 slips were planted without protection. By 1996 all the unprotected plants had been eaten, these plants are not shown in the tables. In 1997 200 whips were replanted in cages.

1995 spring

initial planting	replanted	survival	total planted	survival rate
1080	0	295	1080	27%

1996 fall

initial planting	replanted	survival	total planted	survival rate
1080	0	76	1080	7%

1997 spring

initial planting	replanted	survival	total planted	survival rate
1080	0	74	1080	7%

Replanted in spring of 1997 with only whips

1999 fall

initial planting	replanted	survival	total planted	survival rate
1080	200	124	1280	10%

2001 fall

planting	survival	total planted	survival rate
1280	101	1280	8%

An attempt was made to determine whether surviving plants were rooted stock, whips or slips. Of the surviving 124 plants of 1999, 16 water birch were definitely rooted stock and 10 willows were suspected to be rooted stock. Eight willows were slips and the remainder (90) were whips. In 1999 there were 16 surviving water birch, 42 surviving red willow and 66 surviving sandbar willows.

Meriam

Several hundred slips were planted at this site in early 1992 without beaver protection or irrigation. Survival was limited in 1993 at that time the cattle exclusion fence was removed by a high water event. In 1994 and 1995 only 3 trees were surviving. The surviving trees were located on cut banks that offered protection for beavers and cows. Only one tree could be seen in 2001.

- **Testing of beaver repellents and protection**:
2 commercial repellents, Repellx and Ropel, were used on 5 whips and 5 slips. Neither commercial repellent kept beaver off for more than 2 weeks. 10 slips each were treated with mothballs, blood meal and creosote.
No repellants worked for an acceptable length of time. All plants were eaten within 3 weeks of treatment in all cases.

- **Soils chemistry correlation to survival**

pH, nitrogen, phosphorous, and potassium levels were collected.
A salinity quick test from Natural Resources Conservation Service did not provide enough refinement to be of value.

meamber

Sample	growth	soil moisture	soil type	pH	P	K
m1	good	moist	clayey	8	med high	med
m2	good	dry	silty loam	8	med high	med
m3	poor	moist	silty clay	8	hi	hi
m4	poor	dry	sandy clay	8	hi	hi
m5	ok	dry	silty clay	8	hi	med low
m6	ok	dry	sandy	8	hi	med hi

eckstrom

Sample	growth	soil moisture	soil type	pH	P	K
e1	good		sandy	8	med high	med hi
e2	poor		sandy	8	med high	med hi
e5	good		clayey	8	med high	med hi

No correlation was found between these soil levels and stock survival. Although there seemed to be an observable difference in "native" vegetation at various sites.

- Survival of rooted container stock

Rooted stock of the following species were planted at the eckstrom site.
Willow (Salix laevigata and Salix exigva),
Alder (Alnus rhombifolia),
Cottonwood (Populus trichocarpa)
Waterbirch (Betula occidentalis)

No Alder or Cottonwood survived past the second year (although the several Alders and Cottonwoods were in excellent condition after the first year, a severe drought occurred in that October and apparently killed all of the stock)

- Whips and Slips control site

We found 100% survival for both whips and slips of both species from 1994 to 2001

- Whips and Slips "uncontrolled site"

Eight (330 planted) slips survived at these "moisture stressed' sites. Ninety (330 planted) whips survived after a period of 6 years. The whips and slips were planted next to each other in all cases.

- Cut bank planting survival
In 1994 25 whips were placed in a small (8-foot) vertical cut bank at the eckstrom site.
12 whips survived after one year, 5 after 4 years and two survived in 2001. We found evidence of beaver predation on one of the plants.

- **Dry site test**
- Dry sites vs. irrigated sites

The data from freeman and fiock, irrigated sites and eckstrom, a non-irrigated site.

Irrigated
Freeman 43% survival after 3 years
Fiock 44% survival after 3 years

Non-irrigated
Eckstrom 7% survival after 3 years

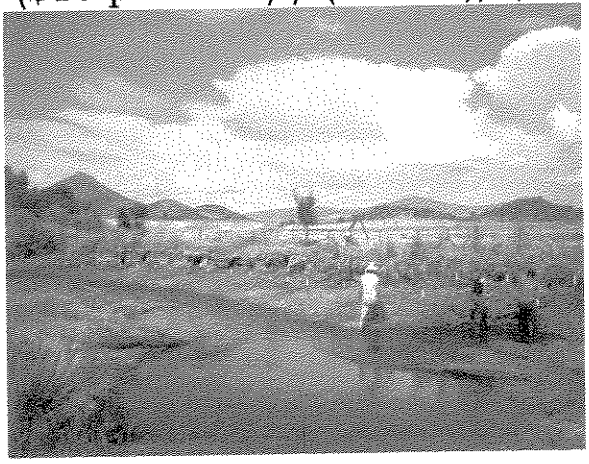
- **Cost of trees, protection and irrigation**

Cost of planting stock

Whips can be prepared nearly 1/3 faster than slips, following is the cost of whip preparation.
Cost of whips
($10 per hour) (1 hour per 50 trees) = $0.20 per tree

Cost of one container stock = $2.00

Cost of planting
($10 per hour) / (60 min)/ (3 min per planting)} = $0.50



Cost of planting = $0.70 to $2.50

Cost of beaver protective cages

Labor
- (10 min per enclosure) x ($10 per hour) = $1.67

Materials
- 36 inches per enclosure- $73.99 per 100 feet) = $2.22

one steel post = $2.30

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cost of one mammal exclosure = $6.20

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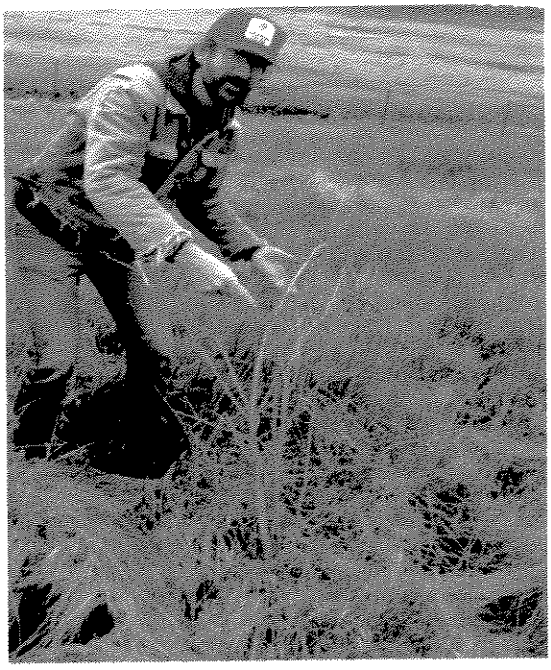
total cost of one tree = $6.90 to 8.70

Irrigation systems cost

An irrigation system was put into place by the California Department of Fish and Game at the freeman site. Pump and distribution pipe cost approximately $1,500.00 for 500 plants. The Californian Department of Fish and Game maintained that irrigation system for 2 years, they estimated that personnel time was approximately 6 man-hours per week from June to October. Based on survival from the Eckstrom plantings we have determined that the critical time for would be from mid of July to the end of October approximately 14 weeks. If a man-hour is valued at $15 per hour the cost to maintain the system is nearly $60 per week or approximately $1260 per season.

An initial cost of $1,500 with a yearly cost of $1,260 for 500 trees for a cost of $5.52 per tree with a second year maintenance cost of $2.52 per tree.



Conclusions

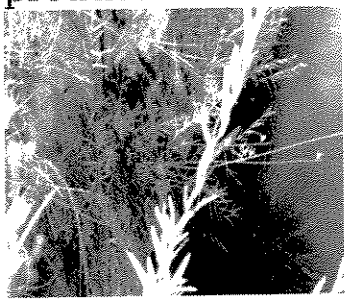
- The alternative to tree planting is, of course, planting no trees at all. Our data shows that natural riparian restoration and natural tree recruitment is extremely slow. The cost of this alternative becomes even greater than that of the plantings. No new tree roots means no new controls on erosion, causing the banks to widen, which in turn will make the water shallower. No new shade will make the water hot due to direct sunlight. Both of these effects will contribute not only to the degradation of the Shasta River but also to populations of fish. It is easy to say that the cost of losing fish like Coho Salmon by far outweighs the cost of planting trees along the Shasta River. Using cheaper, less effective methods may have the same effect as no trees at all in the long term, as trees struggling for survival and unable to provide support for the bank could die or be carried away by the eroding streambank before they could ever reach maturity.

- Clearly beaver control is essential to attempt to meet the goal of river plant restoration. No repellant worked or was cost effective. Wire baskets seem to be the only alternative.

- Soil chemistry tests were unable to predict survival. This may have been a function of the refinement of the tests we utilized. However, the testing kit used is readily available and recommended for non-technical use, that is, a test kit that a producer might be able to purchase.

- Rooted stock did not survive well at non-irrigated sites and so should be discouraged at those sites. Rooted stock did survive when irrigated and will provide species diversification.

- Whips proved to survive at much better rates than the trimed slips and are much easier to produce



- Cut bank plantings are not a method to stabilize those banks.

- Irrigated sites may be able to provide approximately 40% planting survival at a cost of $8.05 - $15.55 per surviving tree. Non- irrigated trees cost $8.75 per surviving tree
(the cost of irrigation varies if the one time cost of pump and distribution line is included).

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